

Plant Extracts Efficiently Decrease the Adhesion of *Campylobacter jejuni* to Human and Animal Intestinal Epithelial Cells

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Received: November 08, 2019; **Published:** November 29, 2019

Campylobacter jejuni is one of the most common causes of bacterial-associated diarrhea in the industrialized world, and is associated with Guillain-Barré syndrome [1]. The highest risk of *Campylobacter* spp. infection resulted from the handling of raw or undercooked poultry meats and resultant cross-contamination [2]. An alarming increase in the prevalence of antibiotic-resistant bacterial strains has been seen, primarily due to excessive and often unnecessary use of antibiotics in humans and animals. Also, modern commercial food production facilitates the emergence and spread of bacterial resistance through the intensive use of antimicrobial agents for cleaning and through international trade of raw materials and food products. Attachment of *C. jejuni* in the gut is an essential step in the infection of the human host, and represents an important virulence mechanism for *C. jejuni* pathogenesis and transmission [3]. Thus, the targeting of bacterial attachment through a mechanism that is not related to bacterial growth inhibition might be of paramount importance in the control of *Campylobacter* contamination. Herbs are a source of a large variety of active compounds that have the potential to inhibit *Campylobacter* adhesion to intestinal mucosa, prevent colonization in poultry, and reduce transmission to humans [3,4]. Anti-adhesive agents like those produced by herbs have a major advantage in combating infections without the selection pressure that results in the emergence of resistant bacteria, while also not causing deleterious effects to the host microbiota [4]. This research presented an alternative strategy for the safe control of *Campylobacter* contamination by targeting their adhesion properties. The study focused on the potential uses of agro-food by-products and waste as anti-adhesive compounds.

C. jejuni K49/4, isolated from poultry meat was grown microaerobically 9 h at 42 °C in Preston prior to infection to allow the transition to exponential growth phase. To prevent adhesion of *C. jejuni* K49/4 to PSI cells (pig small-intestinal epithelial cell line) and H4 cells (human foetal small-intestinal epithelial cell line) the following extracts were used: from grape skins and seeds (*Vitis vinifera*, GSS), thyme (*Thymus vulgaris*) prior to (TE) and the residue after (TE-R) hydrodistillation of the essential oil, extract from leaves of the olive tree (*Olea europea*, OE), and *A. katsumadai* seed ethanol extract (SEE) with its leftover after hydrodistillation of essential oil (hdSEE-R) were all chemically characterized prior to the study. Antibacterial and cytotoxic activities were assessed prior to the adhesion test using MTT assay [5]. All extracts were effective for inhibition of *C. jejuni* adhesion, although they did not inhibit *C. jejuni* growth or kill *C. jejuni* cells at concentrations tested for their anti-adhesion activity (0.2-50 µg/ml). The results demonstrated reduced *C. jejuni* adhesion up to 30 % with extracts (TE and SEE) and also with their waste material (TE-R and hdSEE-R) [6,7]. The SEE and hdSEE-R extracts showed strong anti-adhesion activities against *C. jejuni* for the PSI cells even at very low concentrations. The anti-adhesion activities of these extracts were stable across a large concentration range.

The results of the study suggest that bioactive plant extracts and their waste material, and agricultural by-products can be used as promising novel therapeutic agents, with possible medical and industrial applications. GSS, TE and TE-R, along with the OE, SEE and

hdSEE-R can prevent non-specific and specific cell adhesion of *Campylobacter* to biotic surfaces, and by extension, also inhibit bacterial colonization on epithelial cells. Presumably through inhibition of essential bacterial enzymes, blockage of receptors and bacterial adhesins, these extracts have a potential for prevention and treatment of *Campylobacter* infections.

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